SCIENTIX
The community for science education in Europe

STEM out of the BOX
a STEM approach to non-STEM subjects

As the Crow Flies – Measuring distance

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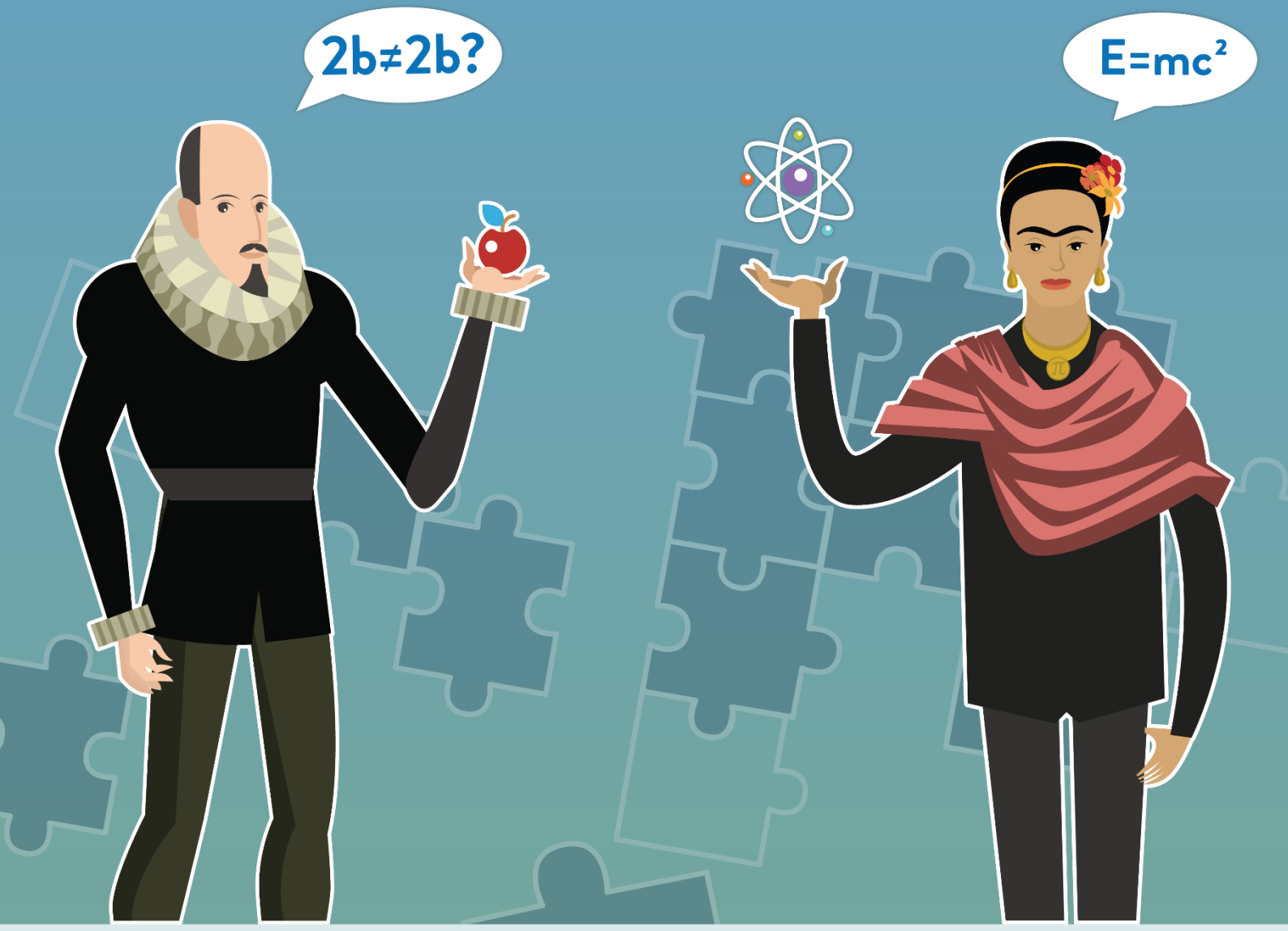

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SCIENTIX LEARNING SCENARIO

Title

'As the Crow Flies' – Measuring distance

Author(s)

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Summary

How long is a kilometre really? Pupils measure distance in their immediate environment and then move on to estimating and finding distances from their location to other locations or landmarks in their country. They then locate a range of European capital cities. They estimate and measure the distances between some of these capital cities using a distance measuring tool. They finally use Google Earth for the last measuring activity. The lesson ends with pupils designing a signpost marker for their chosen location that includes the country colours and distance. These will be used to make a class distance signpost with various locations and their distances on.

Keywords

Distance, Kilometre, Crow flies, Capital cities, Equator

License

Overview

Subject(s)	Geography – map reading, capital cities Maths – calculating distances, measuring History Technology – accessing and using various web tools such as Google Earth, www.freemaptools.com Art Physical education (PE)
Topic(s)	Maps, Earth dimensions, European capital cities, measuring distance using kilometre (km) measures, distance measuring websites/apps, Google Earth, navigating the internet, art, national country colours, imperial and metric measures of distance.
Age of students	9–12 years old
Preparation time	1.5 hours in total Maths – outdoor (kilometre route) – 30 mins Geography (European capitals) – 15 mins Technology – preparing/testing devices and tools – 30 mins Photocopying worksheets – 15 mins Art – 10 mins Other – organising speaker – 20 mins
Teaching time	Three hours for the full lesson (including teacher-led activities, a guest speaker (if available), explanations, examples, and in-class corrections).

	(There is scope for two distinct lessons. One for 90 minutes and another for 80 mins.) Introduction activities, guest speaker – 35 mins PE and outdoor activities – 35 mins Geography – capital cities – 20 mins Maths – measuring distance/using technology – 25 mins Art and showing finished signs – 25 mins Assessment and feedback – 30 mins Plenary – 10 mins
Online teaching material	Internet connection, interactive whiteboard (IWB) or a class projector if a teacher has one. Teacher's laptop, a few tablets/laptops to share among pairs/groups of pupils. Online videos (see below), online websites/apps.
Offline teaching material	Metre stick, personal white boards, markers (for walking circuit), mobile phone with a mapping app such as Strava to measure the one-kilometre circuit), iPads/tablets/laptops, European cities and distance calculation worksheets, IWB, KWL record sheet, art materials including markers, colouring pencils, A4 coloured card, scissors, map(s) of Europe for class sign, flipchart.
Resources used	Guest speaker School playground/field/gym Measuring devices – ruler/metre stick/trundle wheel Online measuring tools – Google Earth, https://www.freemaptools.com/measure-distance.htm **Videos**: 1. YouTube (Walk around the World) https://youtu.be/FL4nMQsp828 2. Google Earth 3. What is a kilometre? https://youtu.be/XzhKc6jD0ws 4. Using Google Earth for calculating distance (dragging points) – this can be used for pupils who finish the distance activity early to find some distances using Google Earth (extension work) https://www.makeuseof.com/tag/google-earth-measure-tool/ 5. Metric vs imperial https://youtu.be/ncPuOpvUvwY 6. Metric system https://youtu.be/NValmBwli1Q **Wikipedia:** How big is Earth? https://en.wikipedia.org/wiki/Earth%27s_circumference

Aim of the lesson

By the end of the lesson pupils should be able to:

-define a kilometre and estimate a kilometre length in their local area,

-open an online distance measuring site, identify two locations, and find the distance between them,

-identify a minimum of five European capital cities,

-explain what 'as the crow flies' means compared to 'road distance',

-find a city using Google Earth and then calculate the distance to it from their own city/town/village,

-produce a piece of ‘distance art’ in the form of a sign to share with the class.

Trends

Peer learning: students learn from peers and give each other feedback throughout the lesson.

Active learning: students are actively engaged with the lessons through discussions, observation, problem solving, case studies, role plays, and other methods.

Collaborative learning: a strong focus on group work and interaction.

Outdoor education: learning outside of the classroom in a ‘real’ environment.

Peer learning: students work in mixed-ability pairs with a focus on collaboration and problem-solving.

STEM learning: increased focus on science, technology, engineering, and mathematics subjects in the curriculum.

21st-century skills

This lesson will focus on several key 21st-century skills:

Global awareness: students will be more aware of their sense of place and have an enhanced geographical knowledge of the planet they inhabit.

Technology skills and digital literacy: students will work predominantly with digital devices to access online websites.

Critical thinking: students will explore ideas and discuss and consider other points of view.

Creativity and innovation: students will discuss and debate the challenge at hand. They will collaborate to generate ideas and hypotheses while learning how to respond to a challenge.

Collaboration: students will complete tasks in pairs/groups.

Communication: students will work on their measuring, reading, writing, speaking, and listening skills to engage in useful discussions and complete lesson activities.

Problem-solving: students will face a real-life problem and develop the ability to find answers.

Social skills: students will work in a group and improve their communication skills as they develop collaborative skills

Leadership and responsibilities: students will develop the ability to guide and motivate each other.

STEM Strategy Criteria

Elements and criteria	How is this criterion addressed in the learning scenario?
Instruction	
Personalisation of learning	The learning scenario is planned so that pupils of all abilities can access the activities either as individual learners or in mixed-ability groups.
Problem and project-based learning (PBL)	Pupils complete an open-ended kilometre measuring activity where the solution and strategies used are

Elements and criteria	How is this criterion addressed in the learning scenario?
	dictated by the students.
Inquiry-based science education (IBSE)	Students use concrete micro and macro examples of measurement to complete additional, more challenging tasks. They first learn by doing and then apply this learning to web-based tasks using questions linked to measuring and distance.
Curriculum implementation	
Emphasis on STEM topics and competences	The learning scenario emphasises key competences in STEM, geography, and art as the lesson is cross-curricular and multi-disciplinary.
Interdisciplinary instruction	The lesson focuses on an explicit merging of STEM, geography, and art. This interdisciplinary aspect is key to the lesson's success. Pupils walk a kilometre, examine kilometres on a map, and explore cities and distances using technology.
Contextualisation of STEM teaching	Measuring and distance are key components of both maths and geography. They are part of everyday life (height, sports, speedometers, road signposts etc.).
Assessment	
Continuous assessment	Formative assessment is conducted in several ways including teacher observation, task completion (distances), and a Kahoot quiz.
Personalised assessment	The lesson is structured to suit a range of learning styles and the opportunities for personalised assessment are varied and broad. The pace of learning and the teaching approaches are structured to suit the varied needs in the class.
Staff professionalisation	
Highly qualified professionals	Teachers undergo in-house STEM continued professional development (CPD) each year and the school engages in local, regional, and national initiatives for best practices and ongoing innovation in teaching and learning.
Supporting (teaching) staff	The school has support staff to supervise students in outdoor activities and assist students who need specific and/or additional support to access the curricula
Professional development	The STEM coordinator organises face-to-face and virtual learning opportunities for all the staff and documents the CPD that individual teachers have taken. This helps us have a clear idea of staff expertise so that it can be utilised effectively.
School leadership and culture	
School leadership	Our principal and board of management place a major emphasis on STEM subjects and encourage teachers to participate in STEM initiatives, at both local and national level. These include the Junior Lego League, Science Blast, and Discover Primary Science awards.
High level of cooperation among staff	Team teaching is a key element of our day-to-day teaching and teachers plan, teach, and assess together in STEM and other subjects.

Elements and criteria	How is this criterion addressed in the learning scenario?
Inclusive culture	We have a unique staff mix with a wide range of expertise and interests. We use this for the benefit of the pupils, and it leads to a respectful environment that fosters cooperation and collaboration throughout the school. We have specialised teachers who have unique STEM experiences and qualifications.
Connections	
With industry	There is a civil engineering firm locally that we could talk to to access a speaker/workshop on planning/design and the importance of measuring, distance, and scale to their jobs.
With parents/guardians	Parents are encouraged to revisit the measuring tasks and online tools and apps at home. This is included as part of homework and allows parents to interact with their child's in-school learning.
With other schools and/or educational platforms	Local schools share some of their STEM resources and lesson plans with the local education centre. They then create a shared repository of resources for all the schools to use.
With universities and/or research centers	It would be beneficial to have a guest speaker either online or virtually and this could be part of a 'Maths Week' or using school connections. It would be especially useful to have a face-to-face or online workshop about distance and measuring and particularly the move from the imperial to the metric system. This would ideally done before this lesson but could be incorporated into it.
With local communities	Students are more motivated to take an interest in their local area, its location, and where we are in this big world. It gives pupils an added sense of place and pride.
School infrastructure	
Access to technology and equipment	Each member of staff has a laptop and class teachers have a modern IWB in their classroom. The school also has a suite of shared iPads and Chromebooks.
High-quality classroom materials	The school provides resources and technology to enable staff to produce high-quality teaching materials while focusing on unique, rich, and individualised rather than generic resources.

Lesson Plan

Name of activity	Procedure	Duration
Initial lesson: interest jooks	*Suggestion – Use the abbreviations 'km' for kilometre and 'm' for metre where possible (this learning scenario is written for the metric system). What shape is the Earth? Show the class a globe (on Google Earth if necessary). Do you think the Earth is the same distance around the equator (show) as it is from pole to pole (show)? What does the term 'as the crow flies' mean? Show an in-class	5 mins

	example.	
Maths: kilometre brainstorm	Complete the KW section of the KWL (see Annex 3, 'As the crow flies' KWL document, and show Video 2 if required). In class: Ask the class what they know about a kilometre (km). Use the question prompts below. How many metres (m) are in a kilometre? How many metres is it from the top to bottom of the classroom? What fraction/decimal of a kilometre is a metre? Do you know an approximate one-kilometre distance locally? What is approximately one kilometre from your school/house? Can you pinpoint a road sign locally and recall what locations/distances are on it? How far is it to your capital city? Write guesses on mini whiteboards. Teacher checks.	15 mins
History: the metric system (in or out of class)	In class. Metric system vs imperial system. Brief introduction, question and answer session. Online guest speaker (could be a maths 'expert' linked to a local education centre or a local/regional maths initiative or a maths specialist in school). If the speaker is not available, the teacher can alternatively show the class videos 4 and/or 5. The teacher writes the main differences between each system on the board/flip chart. 'Metric system versus imperial system' https://youtu.be/ncPuOpvUvwY and/or 'History of measurement' video https://youtu.be/NValmBwli1Q (Teacher decision based on speaker availability)	15 mins
PE/maths: how long is a kilometre? (in or out of the classroom)	Before the lesson begins, the teacher takes the class outside (if not already outside from the brainstorm session, which is preferred). Pupils line up with their partner/group on the playground/field/track and listen to the teacher's instructions. The teacher has pre-designed a one-kilometre route outside using a trundle wheel or a mobile app such as **Strava**. The class breaks into mixed ability pairs that have been allocated in advance by the teacher. (There may need to be a third person in a group depending on class numbers, class dynamics and specific pupil needs). An additional teacher or a classroom assistant is advised for larger classes for student safety and organisation. They walk until they decide they have covered a kilometre. The teacher notes the distance covered for each group.	25 mins
Activity analysis (inside/ outside)	How did the groups do? Did they over/under-estimate a kilometre? How did they decide (count steps, time) the distance? The teacher will later highlight/mark out the one-kilometre route (starting and finishing points) and suggest using this as part of their free time (log their kilometres for a week/month).	10 mins
Geography*:* European capital cities	Pupils work in small groups (2/3). Sizes are dependent on the atlases/devices available. The teacher gives out maps/atlases with European countries/capitals or allows pupils to access an online map: www.geology.com/world/europe-satellite-image.shtml	20 mins

	Students fill in the EU capitals worksheet in pairs (use an atlas or a map of Europe, either physical or online) – Worksheet 1	
Maths and technology: measuring longer distances crossing the globe	Explain the term 'as the crow flies' and show an example of the difference between a 'road measure' and 'as the crow flies'. ('As the crow flies' is an English idiom or expression that refers to the most direct distance between two points. It is a straight-line measure rather than the route a car journey might take. (Suggest a name for the 'class crow'. This adds a bit of humour to the lesson!) How far is it from their location to their capital city as the crow flies?' Pupils write their guesses on the mini whiteboards. Brainstorm on the IWB while looking at a map of the country. The teacher checks using the online tool (as above). How far is it from various capital cities to others? (Work in the set pairs or particular group arrangements as initially decided by the teacher.) Estimate then use a distance tool to find the correct distance). The first example is completed on the worksheet. Example 1: Teacher led using the IWB. Use freemaptools.com to measure the distance between Calais and Cannes in France. 909 kilometres as the crow flies vs 1 201 kilometres road distance. Pupils fill in the first question on Worksheet 2. See annex. Example 2: Having looked at the example what do you think the distance is between Brussels and Paris (is it longer/shorter than our example)? Take oral feedback and record on the IWB. Pupils fill in Worksheet 2 with estimates first. The teacher checks using freemaptools.com and pupils fill in the worksheet. Note: the final activity involves using **Google Earth**. The teacher puts Google Earth on the IWB (www.googlearth.com) and shows them how to use the virtual globe to find their town/city and an unfamiliar city/town in a faraway country. They then find the distance using https://www.freemaptools.com/how-far-is-it-between.htm and log it on Worksheet 2. This will be used as a key element in the final art activity.	25 mins
Art	The teacher hands out a piece of A4 card to each pair and some markers/crayons and/or colouring pencils. They will also need scissors and stencils, if available, for the letters and numbers. The teacher shows them how to make a road sign (see annex) and tells them how to make a road sign shape with their card. From the last Google Earth activity, the groups write the city in large capital letters and the distance beside it on the card. They colour in the sign in the country/city colours (find online if needed). The signs are collected to make a class distance signpost. (See Annex 6: sample picture) Kahoot quiz, see Annex 4 for link Fill in L on the KWL sheet and the self-assessment section at the bottom (see KWL sheet annex). Each child takes a turn on a device to complete their Padlet learning reflection. The teacher reminds students how to use Padlet on the IWB.	25 mins 20 mins

Technology: assessment and feedback	Ask 'from what you know, how long do you think the distance around the Earth is?' Show Earth on a globe or Google Earth. Write down answers on mini whiteboards and feed back to the teacher (show Video 1 if needed). **Answer: 40 075 kilometres at the equator** Then revisit the question from the beginning of the lesson. Do you think the earth is the same distance around the equator as it is from pole to pole? (show) Explain that it is not quite but why? **Reason: Slight bulge at the equator, 40 008 kilometres** https://en.wikipedia.org/wiki/Earth%27s_circumference	10 mins
Oral language: plenary/ distance conundrum	Student feedback (oral). Did you enjoy the lesson? What was your favourite part? Would you like to do a related activity with Google Earth and Google Maps? Did you find the activities difficult? Did you enjoy working in pairs?	10 mins

Assessment

During the lesson there will be different types of assessment used.

This ranges from teacher observation to the teacher checking and marking the written and digital tasks completed. There are pupil self-assessment and peer assessment opportunities incorporating group discussion, debate, and oral feedback.

Formative assessment:

Art (distance showcase). Check the design of the flags and the distance from our village.

Peer assessment

-Estimating what a kilometre is by walking. Logging the estimates. Looking at the estimates given by groups and discussing their estimates with them. Were they too high/too low and how did they collaboratively arrive at their estimate (approximate steps, time lapse, 'good' guess)?

Oral: group estimates before main written activities.

Self-assessment

Padlet. Set up a Padlet account (for free). See the example in **Annex 5**. Each pupil adds to the Padlet. Use words (bullet points) or short phrases to summarise how the lesson went and/or what they learned.

Complete their KWL chart, use emoji ranking (L).

Summative assessment

-Written work – capitals and distance sheets.

-Kahoot – multiple choice capital city/distance quiz (see annex).

Student feedback

Pupil feedback is important for evaluating the lesson from a pupil perspective and for planning follow-on lessons. The oral feedback during the plenary allows pupils' voices to be heard and the emoji feedback allows them to rate the lesson and how much they learnt.

KWL sheet – emoji section **Annex 3** (bottom section).

General reflections taken from the plenary feedback session.

Teacher remarks

This is my first learning scenario and I really enjoyed putting it into action in the form of two 1.5-hour lessons. It catered for a range of learning styles in the class. It could be done in one complete lesson, but that depends on individual school timetables and teacher preferences. The pupils loved the idea of 'naming' their class crow 'Wings' and we carried the theme through the lesson when discussing 'as the crow flies' vs 'road distance'. I used the crow analogy initially when looking at how 'Wings' the crow would get from one corner of the class to another, choosing the direct flight route rather than a zig-zag route between the desks. I should have followed my own suggested preparation times more, especially when working on the technology elements and particularly when pupils were accessing the various online tools. I would advise setting up the online tools before the pupils start. I spent a lot of time assisting pupils who were not as technologically proficient as others. I found the mixed-ability pair work worked very well as we had a limited number of devices and a mix of technical abilities. The pair arrangement meant that we had variation through peer support and additional teacher support when needed and I also varied it by task as Worksheet 2 (Annex 2) has additional activities for those finishing earlier. The active activity (measuring a kilometre) was very good, and I recommend doing the pre-task work in terms of analysing a centimetre and a metre and quick estimating/measuring activities in the class. This gives the pupils more clarity in relation to estimating the actual length of a kilometre when they do the task. The post-task feedback on how the pairs guessed a kilometre was very interesting, with guesses based on steps, time, and 'rough' estimates as to the length of the football pitch we went around. This brainstorming and feedback were key elements in the lesson and gave me added insight into learning styles and problem-solving strategies. The children also loved the Kahoot quiz (Annex 4), and it is a valuable assessment tool. I realised the time allowed was too short, so I extended the time for each question. Padlet (Annex 5) also offered a valuable insight into pupils' interest in and reaction to the learning scenario and is very valuable when planning future learning scenarios. I have included a photo of my class's distance signpost that they completed after the art activity (Annex 6). After completing the lesson, I have decided to take out the need to use Google Earth as a distance measuring tool. Google Earth is now used to find a city/country at the end of Worksheet 2 (Annex 2) while all measuring is completed using https://www.freemaptools.com/how-far-is-it-between.htm.

We got side-tracked a little during the lesson when I mentioned the channel tunnel and the Eurostar. The pupils were mesmerised but were unaware of this modern technological and innovative project. I gave them a link for homework on the topic as it was not part of the learning scenario per se:

https://www.eurostar.com/rw-en/travel-info/the-channel-tunnel

Overall, the pupils really enjoyed their first learning scenario and the combination of STEM and non-STEM subjects. Their positive feedback reflects this.

About Scientix

Scientix, the community for Science Education in Europe, promotes and supports a Europe-wide collaboration among STEM (Science, Technology, Engineering and Mathematics) teachers, education researchers, policymakers and other STEM education professionals. If you need more information, check the Scientix portal, or contact either the Scientix National Contact Point or Scientix Ambassadors in your country.

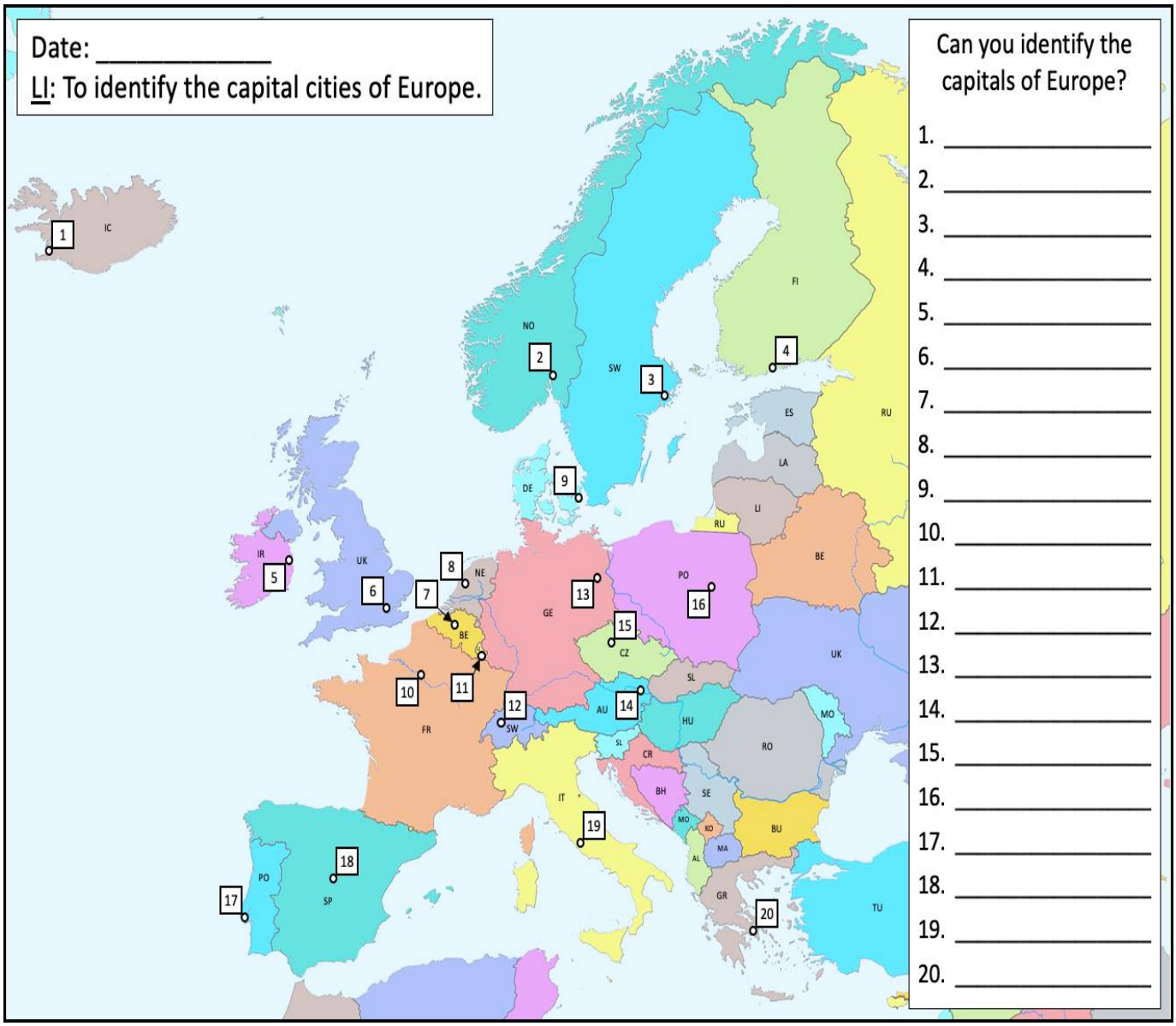
Annex(es)

Annex 1: Worksheet 1 – European Capital Cities

Worksheet 1 Name _____

Date: _____

LI: To identify the capital cities of Europe.



Can you identify the capitals of Europe?

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____

Annex 2: Find the distance **Worksheet 2**

Find the distance - As the crow flies Name:_____

Example (teacher led): Find the distance between Calais (France) and Cannes (France) (Use km for kilometres) Answer-_____km

As the crow flies answer: _____

A

EU capital cities	Distance between the cities my estimate	Actual distance as the crow flies
Paris – Brussels (teacher-led example)		
Madrid – Amsterdam		
Rome – Paris		
Lisbon – Madrid		
London – Dublin*		
Amsterdam – Stockholm		
Warsaw – Berlin		
~		
~		
~		
~		

~ Choose your own EU capital cities to measure

*Discuss with your partner(s): What is different about calculating the distance between this set of cities?

B

Extension activity: open **Google Earth** and find a city in a country you may not know that is a long way from you! Write the name of the chosen city and measure the distance using your distance-finding tool (https://www.freemaptools.com/how-far-is-it-between.htm).

My location	City and country chosen	Distance to city

Annex 3: KWL Sheet

KWL Sheet

As the Crow flies

Name: _____

Topic focus: Distance

How long is a kilometre?

Measuring distance in our local environment, between EU cities and across the globe.

What I Know	What I Want to Know	What I Learned

Pupil feedback (after the lesson): Please circle the correct emoji for each question:

1. **Were you able to do the tasks?**

Yes  Mostly  Some  Very little 

2. **Did you enjoy the lesson?**

Yes  Mostly  Some  No 

3. **Did you learn something new today?**

Yes  Not sure  No 

Annex 4: Kahoot link:

https://create.kahoot.it/share/demystifying-distance/dbccfdff-459a-48d1-b7ed-f3cd4d925968

Annex 5: Padlet link:

https://padlet.com/peterkane631/aevomjgfamtujpoy

(This is an example of a completed Padlet for the lesson and is read only)

Annex 6: Class distance signpost example